Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

TO: Board Members

THROUGH: Kevin Patteson, Executive Administrator
Robert Mace, Deputy Executive Administrator, Water Science & Conservation

FROM: Cindy Ridgeway, Manager, Groundwater Availability Modeling

DATE: October 31, 2014

SUBJECT: Proposed Plan for Developing Groundwater Availability Models

ACTIONS REQUESTED

Briefing and discussion of the Executive Administrator's plan for developing groundwater availability models and consider authorizing the Executive Administrator to publish in the *Texas Register* a Request for Qualifications for projects listed in the attachment for an amount not to exceed $1,440,000.

BACKGROUND

In 2001 the Legislature mandated that the Texas Water Development Board (TWDB) obtain or develop groundwater availability models for all major and minor aquifers in Texas in coordination with groundwater conservation districts and regional water planning groups (Texas Water Code Section 16.012). The Groundwater Availability Modeling Program has completed groundwater availability models for all 9 of the state's major aquifers and 13 of the state's 21 minor aquifers. The remaining minor aquifers are scheduled to be completed using in-house and contracted resources within the next five years.

KEY ISSUES

The proposed plan to develop groundwater availability models consists of three components:

1. Ongoing and scheduled modeling projects by TWDB staff.
2. Ongoing modeling projects funded by Groundwater Availability Modeling Program grants and contracted to technical services firms.
3. Proposed research projects funded by Groundwater Availability Modeling Program grants to technical services firms.

The proposed research projects would support future modeling initiatives and respond to current data needs related to groundwater development across the state.

Modeling projects conducted by TWDB staff

Groundwater Availability Modeling Section staff are responsible for the projects listed in Table 1.

Table 1. Modeling projects conducted by TWDB staff

Model	Scope	Lead Modeler	Status/Anticipated Completion[1]
Llano Uplift Aquifers Groundwater Availability Model	Develop new groundwater availability model	Jerry Shi	Underway – August 2015
Bone Spring-Victorio Peak Groundwater Availability Model	Review and adopt existing model as TWDB groundwater availability model	Cindy Ridgeway	Underway – Mid 2015
Blossom Aquifer Groundwater Availability Model	Develop new groundwater availability model	Shirley Wade	Just started - December 2016
Capitan Reef Complex Groundwater Availability Model	Develop new groundwater availability model	Ian Jones	Underway - August 2015
Gulf Coast Aquifer System (in Groundwater Management Areas 15 and 16) Groundwater Availability Model	Upgrade and improvement of existing models	Rohit Goswami	Just started - December 2016
Marathon Aquifer Groundwater Availability Model	Develop new groundwater availability model	Roberto Anaya	Not yet underway - July 2018

Ongoing modeling projects contracted to technical services firms

Table 2 presents the status of groundwater modeling projects funded by Groundwater Availability Modeling Program grants and conducted by technical services firms.

[1] Schedule based on current staff profile and known workload. Schedules may be affected if priority tasks (such as developing modeled available groundwater values and responding to desired future conditions petitions) require staff attention.

Table 2. Ongoing modeling projects contracted to technical services firms

Project	Scope	Status/Anticipated Completion
Educational Videos	Develop video models suitable for groundwater stakeholders that explain groundwater concepts, modeling. Contract with RPS Espey.	Underway – December 2014
High Plains Aquifer System Groundwater Availability Model	Combine and improve existing models. Contract with INTERA (with Bureau of Economic Geology as major subcontractor) and includes financial contributions from three groundwater conservation districts in the High Plains.	Underway – August 2015
Brazos River Alluvium Groundwater Availability Model	Develop new groundwater availability model. Contract with INTERA (with Brazos River Authority as major team member).	Underway - August 2016

Non-TWDB Modeling Projects

In addition to these contracted modeling projects, districts in Groundwater Management Area 8 have completed a major upgrade to the Northern Trinity/Woodbine Aquifer groundwater availability model. This modeling program is being funded by local groundwater conservation districts for the purpose of using the model for joint planning and generation of modeled available groundwater values. Staff from the Groundwater Resources Division have participated in technical reviews of the model conceptualization and development. The model has been submitted to the Executive Administrator for formal review with the understanding that the model will be approved by the Executive Administrator as the official groundwater availability model for the Northern Trinity/Woodbine aquifers.

Several new models or upgrades of existing models have been or may be presented to the Executive Administrator for review and approval. The Paleozoics Aquifer (North-Central Texas) groundwater model developed by the Bureau of Economic Geology and modified by INTERA was submitted to the TWDB on August 22, 2014. In addition, we understand that two groundwater models may be presented to the Executive Administrator for review: a Kinney County groundwater model upgrade from the current model and a Val Verde County model anticipated to be used for joint planning purposes in Groundwater Management Area 7.

Proposed research projects funded by groundwater availability modeling grants

The Groundwater Availability Modeling Program has funded upgrades of the original models and supported other research initiatives to improve reliability and relevance to the ongoing groundwater management programs required by state law. The following paragraphs identify additional research projects to meet the groundwater modeling needs of the groundwater

community in Texas and to respond to dynamic conditions inherent in the joint planning and regional water planning processes.

The five projects described in the attachment and summarized in Table 3 have been identified by staff after a review of current groundwater availability modeling programs; discussions with various groundwater stakeholders; receipt of verbal and written comments from Groundwater Availability Modeling Technical Advisory Group members before and after the Technical Advisory Group meeting held on July 22, 2014; discussions with staff members in the Groundwater Availability Modeling and Innovative Water Technologies sections; and a consideration of data needs relative to regional water planning groups.

Available funding for these projects in Fiscal Year 2015 totals $1.44 million. Based on staff estimates of the likely costs (and considering our understanding that matching funds of at least $200,000 will be available for project 3) associated with these projects, the cumulative costs of these five proposed research projects exceed our funding allocated for the Fiscal Year 2014 and Fiscal Year 2015 biennium. The Executive Administrator therefore proposes to proceed with the first three projects with funding allocated for 2014–2015 biennium and consider pursuing the last two projects (along with a yet to be determined project) with funding allocated for the 2016–2017 biennium. If the Board is in agreement with the listed projects and their priority, the Executive Administrator proposes to publish a request for qualifications notice for projects one to three, select the most qualified firm for each project, and then present our top candidates to the Board before proceeding to negotiate contracts.

Table 3. Proposed Research Projects for Groundwater Availability Modeling grants

Name	Description	Estimated Cost	Stakeholders/Interested Parties/Proponents
1. Lower Rio Grande Valley Groundwater transport Model	Local groundwater model specifically addressing brackish resources and based on results of Innovative Water Technologies detailed evaluation of subsurface conditions.	$740,000	Regional water planning group, brackish groundwater developers and end-users, Innovative Water Technologies staff.
2. Mapping fresh, brackish, and saline groundwater in Queen City, Sparta, and Carrizo-Wilcox aquifers	Conduct a detailed evaluation of selected areas to improve definition of the lateral and vertical limits of fresh groundwater. Focus will be on the groundwater availability model for the southern portion of the Queen City, Sparta, and Carrizo-Wilcox aquifers mainly in Groundwater Management Area 13.	$380,000	Innovative Water Technologies staff, regional water planning groups, groundwater conservation districts, oil and gas exploration and production interests, irrigation interests.

Table 3. Continued
Proposed Research Projects for Groundwater Availability Modeling grants

Name	Description	Estimated Cost	Stakeholders/Interested Parties/Proponents
3. Effect of faults on groundwater flow in the Carrizo-Wilcox Aquifer in Central Texas and model updates[2]	Evaluate multiple scenarios of fault properties to better model groundwater flow conditions under various stress conditions and update model, as needed.	$520,000	Regional water planning groups, groundwater conservation districts in Central Texas, groundwater developers. and consumers
4. Investigate and estimate volume of pumping that may trigger land subsidence	Identify the sedimentary-based aquifers and using empirical and/or analytical approaches estimate the volume of pumping per county/aquifer/model layer that may trigger land subsidence of 0.1 inch.	$500,000	Groundwater conservation districts, groundwater developers and consumers that use subsidence prone aquifers
5. Simulation of the fresh/saline groundwater interaction in the Barton Springs Segment of the Edwards Aquifer	Develop a local model to simulate conditions between fresh and saline groundwater to assist local groundwater decision makers in management of the brackish groundwater resource.	$600,000	Barton Springs Edwards Aquifer Conservation District, Groundwater Management Areas 9 and 10, groundwater developers and consumers

RECOMMENDATION

The Executive Administrator recommends approval of this item.

This recommendation has been reviewed by legal counsel and is in compliance with applicable statures and Board rules.

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Les Trobman
General Counsel

Attachment

[2] Post Oak Savannah Groundwater Conservation District has received authorization from their Board to contribute up to $200,000 to this project. Other groundwater conservation districts have indicated an interest in contributing funds to updates to the model. The contribution from TWDB is expected to be $320,000 with contributions of at least $200,000 from groundwater conservation districts.

ATTACHMENT

TWDB WATER ASSISTANCE FUND FISCAL YEAR 2014 & 2015
GROUNDWATER AVAILABILITY MODELING PROGRAM STUDIES
SUMMARY SCOPES OF WORK

1. **Groundwater Flow Model for Lower Rio Grande Valley for Brackish Groundwater**

   Estimated Cost: $740,000

   Interest in brackish groundwater as source water for desalination in the Lower Rio Grande Valley is accelerating. The Conservation and Innovative Water Technologies Division has recently completed an assessment[3] of brackish groundwater resources in the Gulf Coast Aquifer System in part of a four-county area in the Lower Rio Grande Valley (TWDB Report 383). Most of the groundwater in the Lower Rio Grande Valley has concentrations of total dissolved solids greater than 1,000 milligrams per liter and does not meet drinking water quality standards. Currently, seven desalination plants treat brackish groundwater for municipal use in the study area. An additional 23 desalination projects have been recommended by water user groups of Region M in the 2012 State Water Plan. Groundwater quantity and quality changes, and potential subsidence are significant factors that must be evaluated in areas where multiple groundwater desalination plants are operating.

   The Lower Rio Grande Valley was selected for a groundwater modeling study because of the anticipated need for additional water in the region and the lack of a groundwater model specifically dealing with the technical issues of brackish groundwater development. At a minimum, the proposed modeling project would update the existing groundwater availability model for the southern portion of the Gulf Coast Aquifer System with a more refined framework and grid that incorporates data from the brackish study. Other objectives would be to investigate the possibility of subsidence or changes in water quality occurring in the area due to long-term withdrawal of groundwater. If these objectives are feasible, the appropriate MODFLOW based model will be produced and documented. If these objectives are not feasible due to insufficient data for calibration, alternative tools will be developed and provided to assist decision makers in developing and monitoring desired future conditions. The project will adhere to groundwater availability modeling standards including documentation and stakeholder involvement.

2. **Mapping fresh, brackish, and saline groundwater in Queen City, Sparta, and Carrizo-Wilcox aquifers mainly in Groundwater Management Area 13**

   Estimated Cost: $380,000

   Planners and decision makers need reliable estimates of available fresh and brackish groundwater to better formulate water management strategies. Currently, the basis for

[3] TWDB Report 383: Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas by J.E. Myer, A. Croskrey, M.R. Wise, and S Kalaswad
http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R383_BrackishGW.pdf

determining the amount of fresh groundwater in Texas has relied on decades-old data. While improved estimates have been made at a local scale[4], the criteria for defining these resources have not been consistent nor have they been defined in a way that is usable on a regional scale used by the Groundwater Availability Modeling Program.

The groundwater availability models are the most common tool to estimate modeled available groundwater volumes. Groundwater availability models are designed to simulate groundwater behavior in aquifers. They do not distinguish between fresh and brackish groundwater.

Presently, to estimate modeled available groundwater values TWDB staff extract data for areas that the groundwater conservation districts deemed relevant within each aquifer or formation in each groundwater management area. In some cases these areas are outside the TWDB designated aquifer boundaries and may include brackish or even extend to the saline portions of the groundwater system. Even when using the TWDB designated aquifer boundaries, portions of the aquifers within the aquifer boundaries may be considered brackish or saline. Each modeled available groundwater report includes a note that not only freshwater but water with higher concentrations of total dissolved solids may be included in the modeled available groundwater estimate.

At this time, there is limited information available to delineate fresh, brackish, and saline groundwater—both vertically and horizontally. Most water supply wells are plugged and/or are not completed near areas with bad water so using geophysical logs from the oil and gas industry is typically the best approach for attempting to make this delineation. However, oil and gas geophysical logs are usually expensive, proprietary, and typically don't start recording until they are deeper than the freshwater zone. TWDB staff members in the Conservation and Innovative Water Technology Division have compiled the most extensive collection of publicly available geophysical logs for many aquifers in the state.

The occurrence of fresh groundwater is a particularly important in dipping aquifers such as the Carrizo-Wilcox and Gulf Coast aquifers. In general the downdip (eastern) boundaries of these aquifers are based on water quality data that were available several decades ago. Since then, additional data has become available allowing us to map the boundary between fresh and brackish water. This project will use currently available information (including geophysical logs accessed by the Innovative Water Technologies staff) from a variety of databases to develop new and updated maps of the resources that can be used by planners and groundwater decision makers. Focus will be on the groundwater availability model for the southern portion of the Queen City, Sparta, and Carrizo-Wilcox aquifers that covers Groundwater Management Area 13. The project will build upon and extend the value of existing studies of fresh and brackish groundwater and will serve as an example and template for possible future regional studies in other aquifers of the state. Staff members in the Conservation and Innovative Water Technology Division are developing local scale brackish studies in the same region and we plan on exchanging data at the beginning and mid-point of this study to complement each of the studies. The final product will be geographic information system (GIS) based

[4] For example, TWDB Technical Note 14-01 (by M. Wise, 2014) investigated brackish groundwater resources in Atascosa and McMullen counties in Groundwater Management Area 13.

application that delineates the fresh, brackish, and saline extent in the downdip portion of the aquifers that is compatible with the modeling data. In addition, a GIS based application will be developed that can calculate and delineate volumes of fresh, brackish, and saline waters by aquifer, county, groundwater conservation district, and groundwater management area.

3. **Effect of faulting on groundwater flow in the Carrizo-Wilcox Aquifer**

   Estimated Cost: $520,000 (including outside participation of at least $200,000 in matching funds)

   The 81st Legislature directed the Texas Commission on Environmental Quality (TCEQ) to conduct a study of the characteristics and impacts on groundwater planning in the Carrizo-Wilcox Aquifer. As part of that study, the TCEQ (contracted with the Bureau of Economic Geology) evaluated the existing three-groundwater availability models for the Carrizo-Wilcox Aquifer. The study concluded that one critical issue deserving attention was whether the central portion of the Carrizo-Wilcox Aquifer model should include faults as barriers to flow and evaluation of the location of such faults. This proposed project will use recently (after the groundwater availability model for the central portion of the Carrizo-Wilcox Aquifer was created) developed subsurface and drawdown information to better define the role that faults have in affecting groundwater flow.

   The central portion of the Queen City, Sparta, and Carrizo-Wilcox aquifers model includes one of the most productive aquifer regions in Texas. The way that the Mexia-Talco Fault zone and other faults in the model have been dealt with has been a concern in Groundwater Management Area 12. The degree to which the faults are sealing has a minor effect on the model calibration but a major impact on predicted future drawdowns because future pumping is anticipated in the vicinity of the faults. Permitting of groundwater from the central Simsboro Formation will likely be affected by district interpretations of results from the model. Since the existing groundwater availability model was developed, additional information on the faults has been gathered via interpretation of pumping tests and analyses of geophysical logs. This study will provide districts and other interested parties in Groundwater Management Area 12 with a technical basis to update the model using recent site characterization information by looking at the sensitivity of model calibration metrics and multiple fault assumptions.

   As part of this project, after the results of the initial fault analyses are evaluated, either the current model or an adjusted model with the faults removed will be updated with corrected estimates of pumping for the Alcoa Mine, the model extended to at least 2010, and the model re-calibrated to groundwater availability modeling standards including documentation and stakeholder involvement.

4. **Investigate and estimate the volume of groundwater pumping that may trigger land surface subsidence**

   Estimated Cost: $500,000

Per Texas Water Code (§36.0015), one of the purposes for the creation of groundwater conservation districts is to control land subsidence. A reasonable approach to control this phenomenon is to understand the relationship between groundwater withdrawals and land subsidence. This project will identify the sedimentary aquifers of Texas and estimate the volume of pumping and/or drawdown that would most likely result in triggering land subsidence per county, aquifer, and model layer (as appropriate to the approach used). Conceptually this information would be considered by the groundwater conservation districts when determining the desired future condition of the aquifers in each groundwater management area. It may also be provided with the estimates of total recoverable storage as something to consider along with possible changes to water quality and surface water/groundwater interactions. The final deliverable will not only detail the estimated minimum amount of pumping that could trigger land subsidence but will also include tool(s) to estimate the amount of possible land subsidence for various pumping volumes per well or county/model layer.

5. **Simulation of fresh/saline groundwater interaction in the Barton Springs Segment of the Edwards Aquifer**

   Estimated Cost: $600,000

   The Barton Springs Edwards Aquifer Conservation District is actively managing the brackish portion of the Edwards Aquifer differently than the fresh water portion. The district defines the brackish Edwards as that area east (downdip) of the 1,000 milligrams per liter total dissolved solids "line." The Barton Springs Edwards Aquifer Conservation District staff have indicated that they do not yet have as firm a scientific basis for managing the brackish portion as they do for the fresh portion that is covered by a groundwater availability model. The district seeks to answer several questions:

   - What happens to the fresh/brackish transition zone when pumping occurs on the brackish side, in other words how does water quality change in the region of the pumped well? They currently define a three-mile wide "buffer zone" where permits are not automatically allowed, but know that the three-mile "buffer" could be refined on the basis of modeling.
   - What effect could pumping on the fresh side, near the transition zone, have on water quality in the area, in other words could the transition zone migrate significantly updip if the aquifer is overproduced near the transition zone?
   - What is the potential for aquifer storage/recovery in the brackish Edwards? Barton Springs Edwards Aquifer Conservation District has reserved, in its rules, a volume of water for permitting in aquifer storage and recovery systems.
   - Can they establish a desired future condition in the brackish Edwards based on flow and potentially transport modeling?

   The proposed project will create a locally refined model that spans the transition zone, and that has sufficient horizontal and vertical resolution to simulate changes in water quality (in other words transport). Variable density modeling should be evaluated for its applicability to answering the above questions.

The proposed project should use the framework of the existing groundwater availability model of the Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer. The project tasks include the following:

- Extend the active portion of the groundwater availability farther downdip into the brackish region, and also further to the southwest along strike.
- Update the groundwater availability model to include recent years, where head measurements have been made in the brackish Edwards.
- Follow groundwater availability modeling standards including documentation and stakeholder involvement.

This proposed project would represent an example of a model designed for considering water quality/brackish groundwater availability in the context of groundwater management and joint planning activities.